Technical Description/Installation manual

Synchro/Stepper - NMEA converter S2N U/N 9028C

SW 99002 ver 0.6-1 and later

Safety precaution!
Although the unit is powered from nominal 24 V DC, the voltages for some gyro synchro and/or stepper formats may be higher than 48 V and care must be taken since these voltages may be dangerous.

Installation shall only be done by qualified persons.

There is no galvanic connection between input terminals R1-R2 and S1-S2-S3 and unit case or any other connections of the unit.

Note! This Technical Description is used also for version bare board versions 9027C and 9033C without displays as well as for earlier SW versions, certain sections below are not applicable for this.

1. Brief Description

The serial point-to-point communication method described in NMEA 0183 and its international companion standards IEC 61162-1 and -2 will be in use for long times to come.

A consequence of that is that there is a strong need for efficient ways to transfer data from other electrical interfaces, such as the widely used synchro transformer format to complex systems, like integrated bridge systems, VDR and AIS.

The Synchro – NMEA converter unit described here is intended to fulfil this requirement by using efficient circuitry to solve the required task only.

The default setting converts from standard synchro format (any common voltage, including 115/90 and 26/11.5 V 50-500 Hz) to $HEHDT transmitted each second or from $^1/_6°$ stepper.

Conversion from more unusual formats with different geared ratios can be done using the NMEA input for set-up/calibration and alignment.

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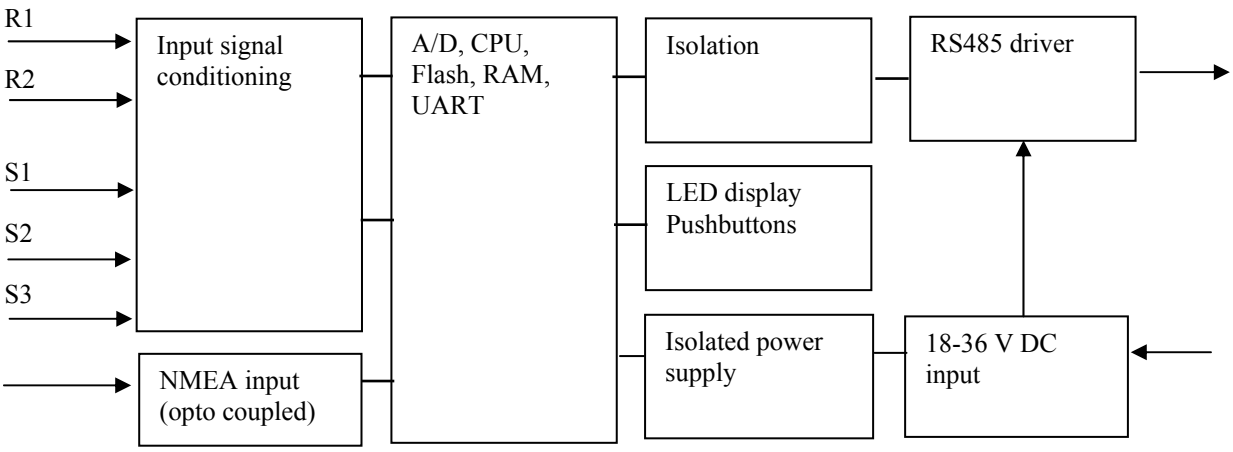
2. Block diagram



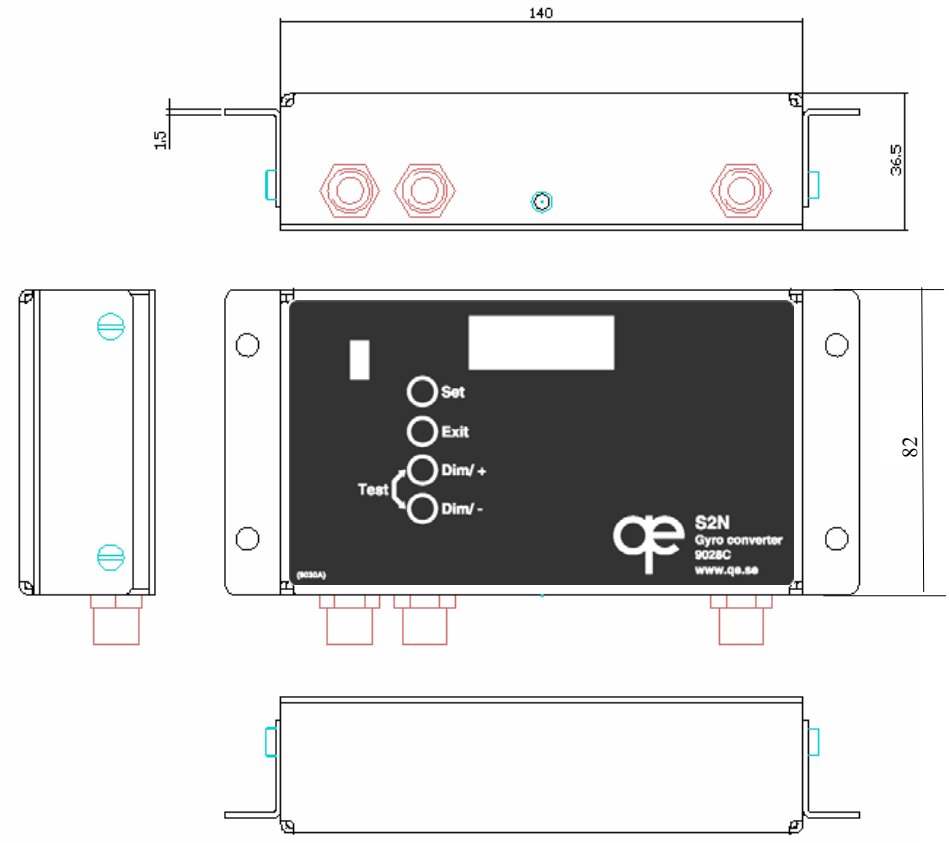
The power supply for the internal circuitry is isolated from the ship's power supply input, and the NMEA input for set-up/alignment (where needed) is opto-isolated.

The main NMEA output, based on a RS485 driver circuit, is fully compliant with the IEC 61162-2 specification and powered from the power intake supply (isolated from the internal supply), which shall be connected only to fully isolated NMEA/IEC compliant inputs, resulting in full isolation of input and output signals.

Even in the event of an erroneous grounding of the main NMEA output (for instance to a non-isolated serial input), there is still no electric connection to the input circuitry and the internal electronics.

3. Technical data

3.1. Mechanical



Dimensions:	Box (without mounting flanges and cable glands) 140 x 82 x 36 mm, mounting flanges adds 15 mm on each side and can be mounted for panel mount (shown) or for bulkhead mount.
Mounting:	Front panel mounting in 145 x 82 mm panel opening. Bulkhead mounting on any flat surface. For bulkhead mounting in very tight spaces, it is possible to rotate the side flanges "inwards" to minimise bulkhead footprint. Mounting holes dia 6 mm (suggested bolt dia 5 mm), spaced 158 x 52 mm (w x h), centered and aligned with front panel.

Mechanical mounting data for bare board versions 9027C and 9033C are available on request.

3.2. Inputs

3.2.1. Synchro/Stepper inputs S1-S2-S3, R1-R2

Phase voltages:	90 V nominal. Minimum nominal voltage in 90 V setting 22 V (SW 0.4-1 and later).
Phase load:	Appr 47 kΩ symmetrical load to internal AGND, floating. Note! "Open collector" or similar stepper outputs requires external voltage and load. Internal jumper P13 can be used to connect internal AGND to input terminal R1.
Reference voltage:	10 to 120 V RMS AC
Reference frequency:	Settings for 50/60 Hz, 400/500 Hz or 20/1000 Hz
Gear ratio:	Synchro 1:1, Synchro/Stepper 1:36, 1:45, 1:90, 1:180 and 1:360 values settable using serial terminalt, proprietary NMEA set-up control or using internal key/display.

3.2.2. NMEA 0183/IEC 61162-1 set-up/alignment input

Input circuit:	Fully NMEA 0183/IEC 61162-1 compliant, optically isolated.
Connections:	Spring-loaded terminal block, accepting up to 2.5 mm² cable ends, marked "NMEA IN A" and "NMEA IN B".
Baud rate:	4 800 b/s, 1200 to 57600 settable.
Message format:	Proprietary "$PQWE" messages for set-up and alignment, simple menu driven text terminal mode with JP7 set, see set-up section.

3.3. NMEA 0183/IEC 61162-1 or -2 main output

Output driver:	Based on RS485 driver, with differential signalling using 0 and +5 V, fully compliant to IEC 61162-1/-2 standard. Output driver is powered from regulated DC input and should be connected to isolated NMEA 0183/IEC 61162-1 or -2 receivers.
Output current:	50 mA maximum
Connections:	Spring-loaded terminal block, accepting up to 2.5 mm² cable ends, marked "NMEA OUT A", "NMEA OUT B" and "NMEA OUT C".
Polarity:	"A" connection idles negative referred to "B".
"C" terminal:	This is included for full IEC 61162-2 compliance, intended for inner screen or separate grounding wire and is internally connected to ground voltage of output driver. Common installation practice for standard NMEA 4 800 b/s operation is to use shielded, twisted pair cable and to connect shield in transmitting end only.
Baud rate:	4 800 b/s, 1200 to 57600 settable.
Message formats:	Standard "$HEHDT" with one decimal, transmitted at 1 Hz, which is appropriate for VDR/AIS installations. New "THD" (expected in next version of standard) or "HDM" sentence formatters, talker identifiers and transmission frequency and averaging properties can be tailored to suit any situation, see set-up section for this.
Rate of turn:	"ROT" rate of turn can be extracted from heading information, see set-up section.

Other formats: Special functions, such as angle to speed or conversion form angular value to any other required serial format can be done on request.
Set-up: As a part of set-up procedure, proprietary "$PQWE" messages are being transmitted, see set-up section.

3.4. Performance

3.4.1. Synchro operation

Inaccuracy: Better than 0.1°, jitter 0.02-0.05° using 1:1 synchro input and operating at phase voltages down to 50% of nominal voltage.
Resulting resolution in 360:1 system down to 0.00003°
Update rate: 1 Hz default, 2, 5, 10, 20, 30 or 40 Hz as required.

3.4.2. Stepper operation

Inaccuracy: As defined by stepper format.
Update rate: 1 Hz default, 2, 5, 10, 20, 30 or 40 Hz as required.
Tracking rate: At least 120 steps/second for DC step 20 V and above. Restricted tracking rate for DC step down to TTL level and for rectified AC operation.

3.5. Keys, indicators , jumpers

Keys: "Set", "Exit", "Dim/ +" and "Dim/ -" keys for alignment, setup and display dimming, all with backlit text. Pressing "Dim/ +" and "Dim/ -" keys simultaneously tests all LED elements.
LED indicators: Five seven-segment LED indicators for display of heading.
Jumpers: Four jumpers, P6, P7, P8 and P13 are available.

3.6. Power supply

Power requirement: 18 – 36 V DC, less than 2 W power consumption. Note! Operates typically down to less than 10 V, but this is not guaranteed. Operation on 4.5-9 V DC or 9-18 V DC or AC on request.
Isolation: Internal circuitry is powered using an internal isolated DC/DC converter, main NMEA output driver is powered by 5 V DC, down-regulated from DC input. Pads on mounting screw holes or internal ground plane are not connected to DC intake.

3.7. Environmental/Type approvals

Requirements: Compliant with environmental requirements as defined by IEC 60945. Gyro conversion performance is in compliance with IMO performance standards for gyro compasses.
Type approvals: BSH/6161/001/2004, see section 10 for certificate.
CE marked according to EMC directive, see sec 9 for declaration of conformity.
Test reports are available on request.

3.8. Disclaimer

All data in this specification are preliminary and may change without prior notice.

This unit may, as any other electronic device, malfunction due to internal hardware or software failure or due to input signal, configuration, set-up or compatibility problems. If the output from the unit is connected to other systems, these should be operated in such a way that such alfunction can be detected and corrected, avoiding damage or danger. Qwerty-elektronik will not in any case assume any responsibility for any direct or indirect malfunction for the reasons mentioned, other than replacing units under explicitly agreed guarantee conditions. Qwerty-elektronik will also not take any responsibility for any damage or injury caused by electric voltages fed from other equipment, such as gyro compasses.

4. Installation and set-up

Note! Some gyro voltages may be hazardous and the cover plate of the unit shall only be opened by qualified personnel. No such voltages are accessible outside the unit.

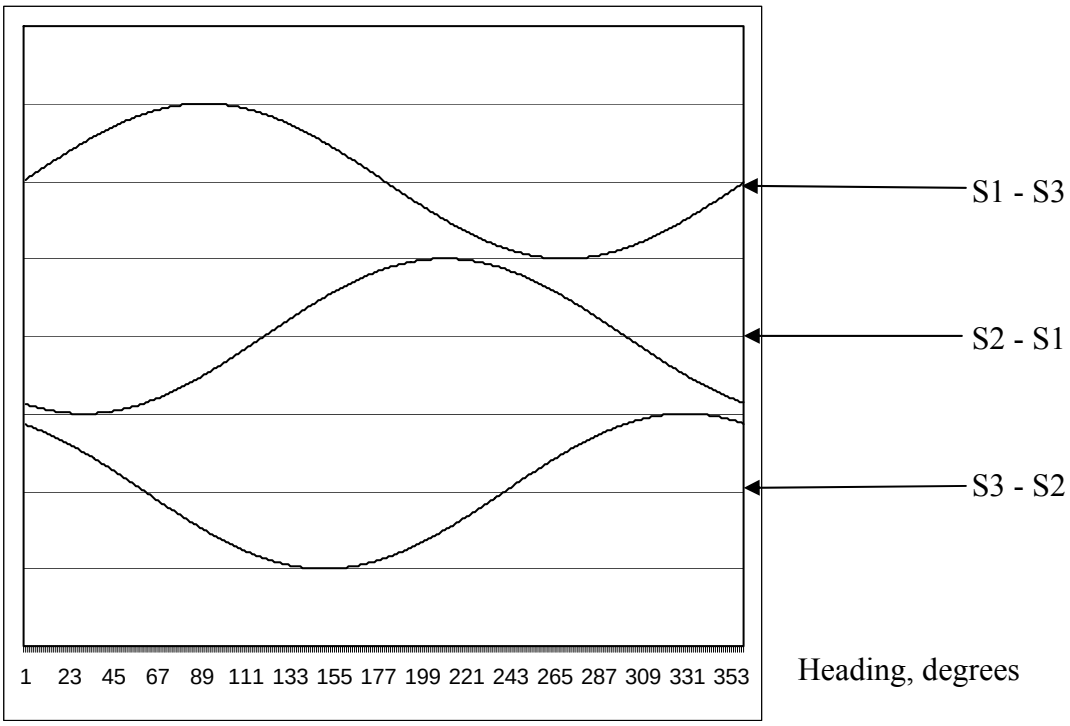
4.1. Gyro output formats and connection to signals

Note! EMC compliance using the boxed version 9028C requires all connection to be made using shielded cables only. Please note that the cable glands are designed to connect to the cable screen. To make this connection, remove the outer insulation of the cable and trim the exposed shield to be some 5 mm in length, then push it down over the outer insulation and push the shield until it connects to the contact fingers.

For bare board versions 9027B, 9027C and 9033C, responsibility for EMC requirements compliance has to be solved by external mounting/installation/shielding.

4.1.1. Synchro – brief description

The diagram shows the amplitude variations as a function of the heading.



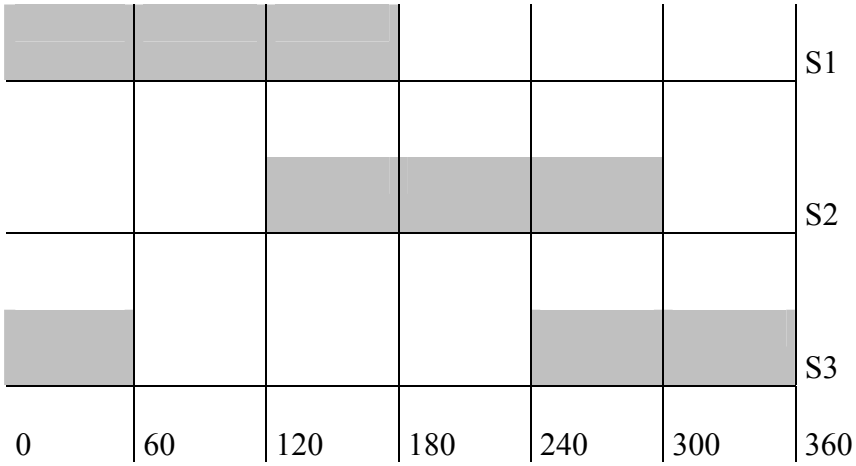
In the synchro transformer format, the angular value is transmitted using a rotating transformer with three windings, spaced 120º.

All three windings carries signals derived from the same reference signal and the ratio (and polarity referred to the reference signal) between them defines unambiguously the angular value of the rotor, meaning that for a 1:1 gyro where the rotor is connected directly to the gyro sensor the angular value directly represents the heading shown by the gyro.

Geared systems, where the synchro rotates a certain number of revolutions for a full 360° turn of the ship, provides higher resolution, but the unambiguity of the 1:1 system is lost, meaning that the interface unit needs to know the heading initially, much in the same way as it would be possible to keep track of the time by only observing the minute hand of the clock face if You are only told initially what the hour is.

4.1.2. Stepper

Diagram of stepper output signals



The similarity of the synchro format should be noted, although the three phase signals can only assume one of two different states, on and off, meaning that each revolution is only subdivided into six sectors, each 60º.

This means that to be of any use defining the heading from a gyro compass, stepper systems are always geared, the most common system being the six steps per degree format, where each degree is subdivided into six sectors.

4.1.3. Identifying signals to connect to interface unit

Technical documentation of the gyro may give useful information.

The best choice for connection to interface is if the gyro has a 1:1 synchro output since this format will avoid any alignment procedures while still maintaining the full 0.1° resolution.

Note: Connection to 1:1 synchro output requires all five connections to be correct:

- Shifting any two wires S1-S2-S3 changes direction of turning.
- Permutating one step S1-> S2, S2 -> S3 and S3-> S1 changes reading 120°
- Shifting R1 and R2 changes reading 180°.

If this is not the case, or if gyro documentation is not available, the signals from the gyro would have to be used, regardless of the format.

To find out if the signals available are of the synchro or the stepper format, proceed as follows:

If the connections consists of five wires and two of these carries a constant (not affected by the ship turning) 115 V - 26 V AC voltage at 400 or 50/60 Hz, this means that the signal is of the synchro type and the signal pair thus localised is the reference signal, which should be connected to the R1-R2 inputs. Don't be too worried about polarity, wrong connection will only give a 180° error that could be compensated for later.

Connect the other three signals to S1-S2-S3, again observing that getting the signals wrong would cause an angular displacement and/or the wrong direction of turning.

If this constant AC voltage pair is not found, the connection is of the stepper type and the task in this case is to locate the three wires that will carry a turning dependant voltage (see diagram above) referenced to the fourth one.

Connect these three wires to S1-S2-S3. Other wires are not required. Note that the Phase inputs S1-S2-S3 are floating and that stepper outputs with "open collector" or similar requires load from connected repeater or resistors to common ground wire. As an alternative, internal AGND (with 47 kohm to each phase input) can be connected to input terminal R1 using jumper P13.

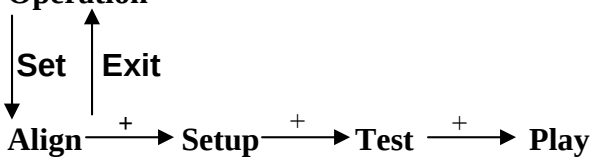
4.2. Set-up using internal display

Note! This section is not relevant for version 9027B without display!

Keys

"**Set**" Enters data or enters menu
"**Exit**" Exits data entry or menu
"**Dim/ +**" In heading display, Dim+, others increment menu or data
"**Dim/ -**" In heading display, Dim-, others decrement menu or data

Graphical overview of menu system:



4.2.1. Alignment mode

This mode is used to align the gyro converter output with the sensed heading of the gyro compass when operating from geared synchro or stepper.

Pressing "Set" displays "A XXX.X" with a blinking "A". With the "+" and "-" keys the displayed heading will increment or decrement. Once values displayed on S2N (or on equipment connected to it), press "Set" and the unit will directly return to normal operation.

4.2.2. Set-up mode

This mode is used during installation to adopt S2N to the gyro output format.

Pressing "Set" displays "P X", where "X" is the main menu number is listed below. Pressing "Set" again displays "P X.Y", where "Y" is the submenu number.

Description of the Set-up menu system:

1 Product data, Read only.

1.1 Product, e.g. 9027 (designation is for bare board version, used in all S2N configs)
1.2 Product rev, e.g. C0
1.3 Production year
1.4 Production month & day
1.5 Serial number
1.6 Boot
1.7 Boot version
1.8 Application
1.9 Application version
1.10 Application download year
1.11 Application download month & day
1.12 Runtime limit, if active

2 Main mode

2.1 Main mode [synchro | stepper]
2.2 Log level [none | debug | info | disturbance | recoverable]

3 NMEA

3.1 Baudrate [1200 | 2400 | 4800 | 9600 | 19200 | 38400 | 57600]
3.2 Power on message [off | on]
3.3 ROT message [off | HE | TI | II]
3.4 Heading update rate [1 | 2 | 5 | 10 | 20 | 30 | 40] times/sec
3.5 Heading sentence [HDT| HDG | THD]
3.6 Heading talker id [HE | II]
3.7 Transmit checksum [off | on]

Note: 40 Hz output rate is only possible with SW ver 0.6-0 and later.

4 Synchro

4.1 Input range [11V | 90V]
4.2 Gear ratio [360x | 180x | 90x | 45x | 36x | 1x]
4.3 Reference frequency [DC | AC/20-1000Hz | 50-60Hz | 400-600Hz]

5 Stepper

5.1 Gear ratio [360x | 180x | 90x | 45x | 36x]

6 Preset

6.1 Preset values [off | default | sync-1 | sync-2 | sync-3 | sync-4]

Choosing one of the preset values will affect other settings under sections 2, 3, 4 and 5 above according to the table below:

Preset value	**Off**	**Default**	**Synchro-1**	**Synchro-2**	**Synchro-3**	**Synchro-4**
2.1 sync/step	No change	Stepper	Synchro	Synchro	Synchro	Synchro
3.1 Baud rate	No change	4800	4800	4800	4800	4800
3.2 Power on message	No change	On	On	On	On	On
3.3 ROT message	No change	Off	Off	Off	Off	Off
3.4 Heading update rate	No change	1 Hz	1 Hz	1 Hz	1 Hz	1 Hz
3.5 Heading sentence	No change	HDT	HDT	HDT	HDT	HDT
3.6 Heading talker id	No change	HE	HE	HE	HE	HE
3.7 Transmit checksum	No change	On	On	On	On	On
4.1 Input range	No change	>20 V	22 (90) V	90 V	22 (90) V	90 V
4.2 Gear ratio	No change	N/A	360x	360x	90x	90x
4.3 Reference frequency	No change	N/A	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
5.1 Gear ratio	No change	180x	N/A	N/A	N/A	N/A

If a certain pre-set is chosen, it is still possible to change any of the settings using the menu system described above. The last setting made always has priority.

List of common gyro types for the presets above (always consult gyro documentation if possible, qe cannot guarantee accuracy of data in this list):

Default (Stepper 180:1)
Furuno GY-700

Tokimec MK-14, MOD-1, 2, T, NK-EN, NK-E1, SR-130, 140, TG-100/5000, PR-357, 130, 140, ES-17, GLT-201, 202, TG-8000, SR-120, ES-16, MK-20
Amabrown MK-10, MKL-1, series 1351, MOD-4
Robertson SKR-80

Synchro-1 (Synchro 360:1 22V 50/60 Hz)
Anschütz STD 2 & 3
Yokogawa Nantec C-1, 1A, 2, 3, A-55, B55

Synchro-2 (Synchro 360:1 90V 50/60 Hz)
Anschütz STD 4 & 5
Yokogawa Nantec CMZ-100, 200, C-JR, D-1Z, 1, 3, IPS-2, 3
Plath Navigat II, III

Synchro-3 (Synchro 90:1 22V 50/60 Hz)
Tokimec ES-11A, TG-200, PR222R, PR237L/H, GM21

Synchro-4 (Synchro 90:1 90V 50/60 Hz)
Tokimec GM-11
Kawasaki GX-81

Example
Setting unit to Stepper mode with 5 Hz update of HEHDT, ROT conversion to TIROT on:

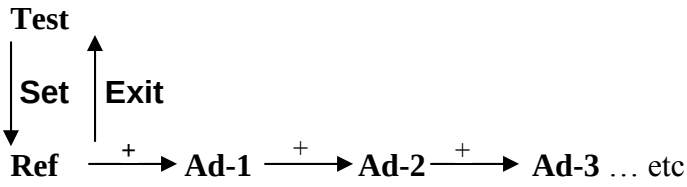
- Press “Set”, display shows text.
- Press “Dim/ +” and “Dim/ -“ keys until “ALiGn” is shown.
- Press “Set”, display shows “1”
- Press “Dim/ +” and “Dim/ -“ keys until “2” is shown.
- Press “Set”, display shows “2.1”
- Press “Set”, display shows “SynCr”
- Press “Dim/ +” and “Dim/ -“ keys until “StEP” is shown.
- Press “Set” to enter this, display shows “2.1”
- Press “Exit, display shows “2”
- Press “Dim/ +” and “Dim/ -“ keys until “3” is shown.
- Press “Set”, display shows “3.1”
- Press “Dim/ +” and “Dim/ -“ keys until “3.3” is shown
- Press “Set”, display shows “oFF”
- Press “Dim/ +” and “Dim/ -“ keys until “tI” is shown
- Press “Set” to enter this, display shows “3.3”
- Press “Dim/ +” and “Dim/ -“ keys until “3.4” is shown.
- Press “Set”, display shows “1”.
- Press “Dim/ +” and “Dim/ -“ keys until “5” is shown.
- Press “Set” to enter this, display shows “3.4”
- Press “Exit”, display shows “3”
- Press “Exit” to revert to normal operation

All set-up data is stored in internal non-volatile EEPROM when leaving set-up menu system and returning to normal operation and this write operation may take a couple of seconds to complete!

4.2.3. Test mode

This mode is useful for trouble-shooting during installation.

Pressing "Set" will enter submenus, which can be used to check input voltages etc. Description of "Test" menu/sub-menu system:



"Ref"
Pressing "Set" in this submenu will display the frequency of the synchro reference voltage as connected to R1-R2 in Hz. "Exit" returns to "Ref" submenu.

"Ad-1", "Ad-2", "Ad-2"
Pressing "Set" in these submenus will display the value read on the three A/D converter inputs expressed in percent of full range. Note that each A/D input is referenced to a common, floating ground, which is not connected to any point outside the unit. "Exit" returns to "Ad-X" submenu.

"S1-S3", "S3-S2", "S2-S1"
Pressing "Set" in these submenus will display the difference between the corresponding input channels as seen via the A/D. "Exit" returns to "SX-SX" submenu.

"Step"
Pressing "Set" in this submenu will display "X X X", where the three characters represents the polarity of the three inputs S1-S2-S3, expressed as "L" or "H". "Exit" returns to "Step" submenu.

4.2.4. Play mode

This mode is useful for testing installations and performs and executes a pre-programmed sequence of turns. *Note: Dynamic playback only works if the unit is set to Synchro 1:1 mode!*

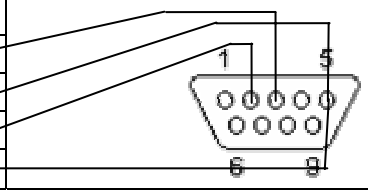
Pressing "Set" will display "no", and by changing this to a "Yes" using the "+" key and then pressing "Set", the playback will commence, displaying "P XXX.X" with a blinking "P". Exit returns to "Play" submenu.

4.3. Terminal style set-up using serial input

Set-up is performed using a simple TTY-type, text based interface. An asynchronous serial terminal (most common would be a PC running Windows-based HyperTerminal or any other terminal-emulating software)

4.3.1. Connecting to PC/Terminal

Connect to a RS232 serial port of a PC as follows:

Connection S2N	**Connection PC**	
NMEA IN A		The serial 9-pole male Dsub connector shown as viewed from the outside, pins pointing towards the viewer!
NMEA IN B		
NMEA OUT A		
NMEA OUT C		

Caution: Connecting directly to RS232 port as defined above will make NMEA output C (= internal GND) connected to ground connection of the used computer. This may cause ground failure indication of the ship, unless an isolated (notebook) computer is used. Note that some older computers will not accept a zero voltage as low, making it necessary in some cases to use the NMEA

OUT B rather than C to RS232 GND. For a 25-pole Dsub use pin 3 instead of 2, pin 2 instead of 3 and pin 7 instead of 5.

Note: Polarity designations "A" and "B" are well-defined in NMEA standard, as well as RS232 connections of a PC, but designation of balanced RS422 ports using "+" and "-" is somewhat unclear, flavoured by the fact that polarity designations "A" and "B" of commonly used RS485 driver circuits is reversed compared to NMEA usage! Using wrong polarity will cause display of unreadable characters, try other polarity to resolve!

Terminal settings:
Baud rate: 4 800
Data bits: 8
Stop bits: 1
Start bits: 1
Parity: Off
Flow control: Off/No

To start the set-up mode in S2N, install jumper P7 and power up the unit.

S2N will identify itself by:

```
_____________________________________
Product: 9027C0 sn:10010 2003-sep-24
Boot: 99001 V0.2-11-1
Application: 99002 V0.6-0 2003-aug-5 size:32680 CRC:57357

Main menu
0. Exit to normal operation and store changes
1. Revert to last saved parameters
2. NMEA
3. Synchro
4. Stepper
5. System info
6. Measurement & calibration
```

All set-up functions are performed via this simple menu system. For each menu, the desired function or sub-menu is chosen by entering the line number of that function, while entering a "0" will always exit the submenu/menu.

A time-out will always exit to normal operation if no input is received within 30 seconds, regardless of the setting of jumper JP7.

4.3.2. Sub-menu 2, NMEA parameters

Entering "2" will output l the following sub-menu:

```
NMEA menu
0. Exit
1. ROT disable
2. Set NMEA update frequency (=1 /s)
3. Set NMEA baudrate (=4800 bps)
4. Set NMEA talker id (='HE')
5. Set NMEA header sentence (='HDT')
6. PQWE0 at reset disable
7. Log level INFO
```

```
8. NMEA check disable
```

This menu is used to set the NMEA parameters.

```
ROT disable
```

Entering “1” will toggle computation and insertion of NMEA ROT message between off and on with “HE”, “HC”, “TI” and “II” sentence formatters.

```
Set NMEA update frequency (=1 /s)
```

Entering “2” will display a choice of updating frequencies 1, 2, 5, 10, 20, 30 and 40 Hz. Note that the higher update frequencies will cause severe NMEA channel load and that 30 Hz setting is only possible using baud rates higher than 4 800.

```
Set NMEA baudrate (=4800 bps)
```

Entering “3” will give a choice of baud rates 1 200, 2 400, 4 800 (NMEA 0183 and IEC 61162-1 standard setting), 9 600, 19 200, 38 400 (NMEA 0183 HS and IEC 61162-2 standard setting) and 57 600.

```
Set NMEA talker id ('HE')
```

Entering “4” will give a choice of different talker identifier settings.

```
Set NMEA header sentence ('HDT')
```

Entering “5” will give a choice of different sentence formatters.

```
PQWE0 at reset disable
```

S2N will identify itself using a valid “$PQWE0” proprietary message and entering a “6” will enable/disable this function.

A typical message will look like:

```
$PQWE0,9027/B0,10004,99002/0.2-0
```

Where “9027/B0” is the unit number of S2N, including the revision designator, “10004” is the serial number and “99002/0.1-2” is the software designator with definition of version status.

```
Log level INFO
```

Entering “7” will give a choice of log level information.

```
NMEA check disable
```

Entering “8” will toggle generation of NMEA check sum on and off.

Note that all NMEA 0183 versions from 2.30 and IEC 61162-1 require this to be left in its “On” state for standard compliance.

4.3.3. Sub-menu 3, Synchro parameters

Entering “3” will output the following sub-menu:

```
Synchro menu
0. Exit
1. Change from Synchro to Stepper
2. Set synchro gear ratio
3. Auto set synchro input range
4. Change input range from 11V to 90V
```

```
5. Set synchro reference frequency
```

Entering “1” will change the setting to stepper format.

Entering “2” will give access to a submenu where gear ratios 360, 180, 90, 45, 36 and 1:1 are possible to set. All ratios except 1:1 will require alignment input to start outputting valid data.

Entering “3” will automatically detect the synchro phase voltages and will set the input range scaling to the optimum value.

Entering “4” will over-ride this function, which can be useful in situations where it is necessary to perform set-up without synchro inputs connected.

Entering “5” will display the following menu:

```
Set synchro reference frequency (=AC/20-1000Hz)
0. Exit
1. DC
2. AC/20-1000Hz
3. AC/50-60Hz
4. AC/400-500Hz
```

Entering “1” will put the unit in DC synchro mode, which is most uncommon. This will disable the reference input and tie this positive internally.

Entering “2” will set the unit to AC synchro mode, but it will not check reference frequency. Frequencies lower than some 20 Hz will not give stable output angles and usage of frequencies lower than 50 Hz is not recommended.

Entering “3” will set the unit into 50-60 Hz synchro mode and it will monitor the reference frequency to be within the range 40 – 70 Hz.

Entering “4” will set the unit into 400-500 Hz synchro mode and it will monitor the reference frequency to be within the range 300 – 600 Hz.

4.3.4. Sub-menu 4, Stepper parameters

Entering “4” will output the following sub-menu:

```
Stepper menu
0. Exit
1. Change from Synchro to Stepper
2. Set stepper gear ratio
```

Entering “1” will disable stepper input mode and exit to synchro input mode.

Entering “2” will display a sub-menu setting the stepper resolution:

```
Set stepper gear ratio (=360X)
0. Exit
1. 360X, 6 steps/deg
2. 180X, 3 steps/deg
3.  90X, 1.5 steps/deg
4.  45X, 0.75 steps/deg
```

4.3.5. Sub-menu 5, System information

Entering "5" will output the following sub-menu:

```
System menu
0. Exit
1. Show memory usage
2. Show version
3. Show e2prom file system
4. Unlock run-time limit. Time left 720:00h
```

Sub-menus "1", "2" and "3" are not intended for customer use.

Units for demonstration/evaluation are shipped with a run time limitation set to 720 hours, after which elapsed time operation will discontinue. By entering a code in this menu, it is possible to permanently remove this function.

4.3.6. Sub-menu 6, Measurement and calibration

Entering "6" will output the following sub-menu:

```
Measurement menu
0. Exit
1. A/D measurement & calibration
2. Show synchro angle
3. Change synchro input range from 11V to 90V
4. Measure synchro reference frequency
5. Show stepper relative angle
```

These submenus give access to various functions intended for calibration and for advanced trouble-shooting/debugging and should not be used unless specific documentation describing this is available.

Sub menu 2 displays decoded synchro angle regardless of input signal quality and can be useful during installation for monitoring heading input.

Sub menu 4 can be used to perform a sanity check on the reference frequency connected to R1-R2

Sub menu 5 can be used to check stepper decoding during installation.

Warning! Do not enter "Calibrate" sub- menu system unless proper instructions and required calibration equipment are available!

4.4. Set-up using serial input/output and proprietary NMEA messages

Enter setup mode.

$PQWE1,1

All other NMEA transmissions will stop during setup mode.

Exit setup mode.

$PQWE1,0

EEPROM is stored, normal NMEA transmission is restarted.

Set/get parameter.

If ParameterValue is empty, get is assumed.

$PQWE2,ParameterGroup,ParameterNo,ParameterValue

gives response:

$PQWE3,ResponceCode,ResponceText,ParameterValue,ParameterText

Response codes

0	Ok
1	Not in setup mode
2	Read only parameter
3	Illegal parameter group
4	Illegal parameter number
5	Illegal parameter value

ParameterGroup

1 Product data, Read only.

1.1 Product & rev, e.g. 9027C0
1.2 Production date
1.3 Serial number
1.4 Boot & boot version
1.5 Application & application version
1.6 Application download date
1.7 Runtime limit, if active

2 Main mode, synchro/stepper

2.1 Main mode, 0=synchro, 1=stepper
2.2 Log level, 0=none, 1=debug, 2=info, 3=disturbance, 4=recoverable

3 NMEA

3.1 Baudrate, 0=1200, 1=2400, 2=4800, 3=9600, 4=19200, 5=38400, 6=57600
3.2 Power on message, 0=off, 1=on
3.3 ROT message, 0=off, 1=on
3.4 Heading update rate, 0=1, 1=2, 2=5, 3=10, 4=20, 5=30, 6=40 times/sec
3.5 Heading sentence, 0=HDT, 1=HDG, 2=THD
3.6 Talker id, 0=HE, 1=II
3.7 Transmit checksum, 0=off, 1=on

4 Synchro

4.1 Input range, 0=11V, 1=90V
4.2 Gear ratio, 0=360x, 1=180x, 2=90x, 3=45x, 4=36x, 5=1x
4.3 Reference frequency, 0=DC, 1=AC/20-1000Hz,2=50-60Hz, 3=400-600Hz

5 Stepper

5.1 Gear ratio, 0=360x, 1=180x, 2=90x, 3=45x, 4=36x

Examples:

Host	S2N
<---	$HEHDT...
<---	$HEROT...
<---	$HEHDT...
<---	$HEROT...
--->	$PQWE1,1

get parameter for NMEA baud rate

--->	$PQWE2,3,1,
<---	$PQWE3,0,OK,2,4800baud

set synchro gear ratio

---> $PQWE2,4,2,1
<--- $PQWE3,0,OK,1,180x

set invalid data

---> $PQWE2,3,1,99
<--- $PQWE3,5,Illegal parameter value,,

---> $PQWE1,

5. Error detection and signalling

The unit is, as far as is practicable, designed to detect input signal conditions that indicates that input data is not valid. The behaviour is different depending on chosen mode. The following error types are handled:

0 NMEA messages thrown away due to high serial load.
1 Synchro/stepper input values are incorrect.
2 Synchro reference input is incorrect.
3 Synchro/stepper is not aligned.
4 Run-time limit.
5 Internal queue full.
6 E2 file system error
7 No application.

Errors are signalled in three different ways:

- The display shows “Err X”, where X is the error code.
- The on board LEDs 0, 1,and 2 (LSB – MSB) shows the error code and binary fashion, where LED 3 = lit.
- The NMEA output inserts a $PQWEX message, defined as: ”$PQWEX,ticks,severity,errCode,moduleId,line,errText”, where the errCode is the error code defined above and where the final errText is a verbal description of the error.

5.1. Error 0, NMEA ouput overflow

This can happen if the baud rate chosen doesn’t fit with the chosen output frequency .

5.2. Error 1, Synchro/Stepper values are incorrect

In both synchro and stepper modes, the three input signals S1, S2 and S3 have to fulfil some logic criteria as defined in section “Gyro output formats …”. This means for instance that in stepper mode, at least one signal must have low polarity and one signal must have high polarity. In synchro mode, the sum of the differences of the three different signal pairs must maintain a certain level and these signals have to be at the same or opposite phase as the reference input.

Generally, disconnection of at least one of the input signals will cause this error. Detection will vary due to at which angle it occurred.

5.3. Error 2, Synchro reference input is incorrect

This can occur in synchro mode only, depending on the synchro frequency setting.

- In 20 - 1000 Hz mode, frequencies outside this range (appr) are not accepted.
- In 50 - 60 Hz mode, frequencies outside 10 - 70 Hz (appr) are not accepted.
- In 400 - 600 Hz mode, frequencies outside 300 - 700 Hz (appr) are not accepted.
- In all AC synchro settings, it is required that the reference voltage is larger than appr 2 V RMS.

5.4. Error 3, Synchro/stepper is not aligned

This error condition will be triggered in all “geared” modes (except synchro 1:1) if the unit:

a) is powered up
b) detects an input signal inconsistency as described above.

In this error condition, signalling as described above occurs and:
a) heading output is removed.
b) Display will start to blink with an “A” as the first character.

This condition can only be reset by performing an alignment procedure.

5.5. Error 4, Run-time limit

This can only occur on demo units delivered with a 720 hour run-time limitation and can be cleared by entering an individual code. Please contact qwerty-elektronik for instructions.

5.6. Errors 5, 6 and 7, internal failure

These should not occur on a normal, functional unit. Please contact qwerty-elektronik for instructions. .

6. Operation and alignment

On power-up, the unit will only start operating in synchro 1:1 mode without performing an alignment operation. This is also the case after a black-out or if unvalid input signals are encountered.

If alignment is lost, the unit will automatically go into alignment mode with a flashing “A” preceding the displayed heading value.

6.1. Alignment via NMEA port

By entering a valid $HEHDTxxx.x,T*hh<CR><LF> message on the NMEA input, the unit will adjust itself to that heading and start operating.

Note! This alignment input message will be accepted by the unit also without checksum.

6.2. Alignment via internal pushbuttons

Unit will flash “A” preceding heading value in conditions where alignment is lost, signalling that it is in alignment mode.

Use keys “Dim/ +” and “Dim/ -“ to adjust the displayed heading until it corresponds with the actual heading as indicated by the ship’s gyro. Press “Set” to enter this value and return to normal operation.

7. NMEA messages used

7.1. HDT

HDT is the common true heading format for current NMEA and IEC 61162-1 versions.
`$HEHDT,x.x,T*hh<CR><LF>`

7.2. THD

THD is the proposed new format for heading sensors. It is currently not decided by NMEA standards committee or IEC TC80 WG6 and message identifier is likely to change, use of this should be avoided!

7.3. HDG

HDG is the common heading format from a magnetic compass.

```
$HEHDG,x,x,x.x,a,x.x,a*hh<CR><LF>
 1 2   3   4   5 6   7 8
```

Fields 4, 5, 6 and 7 are always blank from S2N, typical message will look like:

`$HEHDG,x,x,,,,*hh<CR><LF>`

7.4. ROT

ROT is the standard format for Rate Of Turn indication.
$HEROT,x.x,a*hh<CR><LF>

7.5. Proprietary messages

The registered manufacturer's code for Qwerty Electronics is "QWE", meaning that these messages looks like:
$PQWE-,----------*hh<CR><LF>

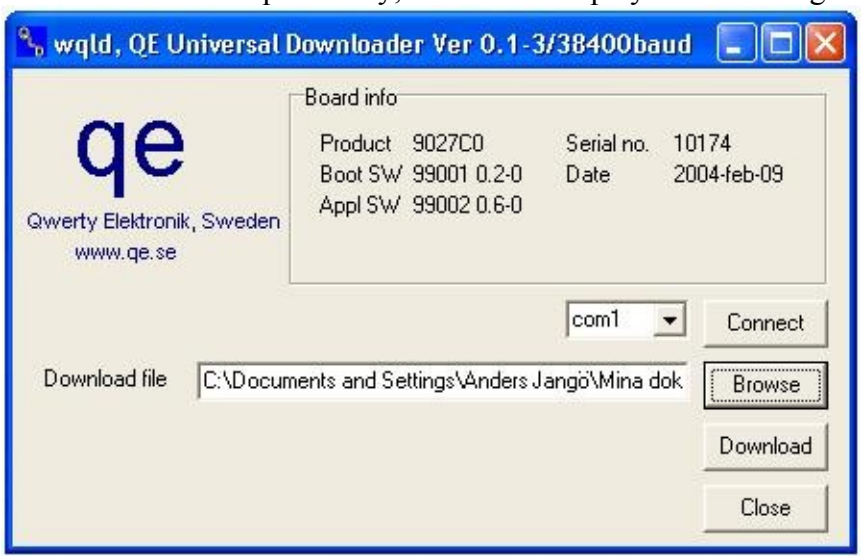
8. Software upgrade via serial port connection

Software upgrade can be performed using a PC with a serial port connected as described in section "Connecting to PC/Terminal"

Make sure that the Windows-compliant software download utility "wqld.exe" as well as the new S2N software "99002_?_?_?.qld" to be installed are available in s suitable location on this PC.

Connect jumper JP6 on S2N board.

Double-click on "wqld" utility, which will display the following window:



Choose the com port used for the serial connection.

Click on "Connect", which will display information about the unit.

Power up S2N, it will search for communication from "wqld" during 30 seconds, during which the upper LED will flash. If the board info fields shown above does not show up within few seconds, perform another off/on sequence on S2N.

Use "Browse" to locate the file containing the software to be downloaded.

Click "Download" to perform the operation and "Close" to exit the utility.

Do not forget to remove jumper JP6 on S2N to return to normal operation directly on power up.

9. CE Declaration of conformity

Doc. No 9080B.doc

Declaration of Conformity

according to the

EMC Directive 89/336/EEC and amendments,
and Low Voltage Directive 73/23/EEC.

S2N Gyro converter

Manufacturer: qwerty-elektronik
Bälinge Klockargård
SE-610 60 Tystberga
Sweden
tel: + 46 70 680 0115
fax: + 46 70 239 17 62
E-mail: info@qe.se
www.qe.se

Equipment: S2N Gyro converter, boxed version U/N 9028C

The above equipment has been tested and, when connected to Synchro or Stepper output of a ship's gyro to produce signals compliant with IEC 61162-1 and IEC 61162-2 is CERTIFIED as complying with the EMC requirements and protection against accidental access to dangerous voltages as defined by:

IEC 60945: 2002

The EMC test report has been issued by:

SP, Borås, Sweden, with designation F319782D, dated 2003-12-10.

The prototype equipment used for certification was fully representative of the production standard.

Date 2004-08-03 Signature: .....
(Anders Jangö, QA Manager)

10. BSH type approval

Bundesrepublik Deutschland
Federal Republic of Germany

Bundesamt für Seeschifffahrt und Hydrographie
Federal Maritime and Hydrographic Agency

BUNDESAMT FÜR SEESCHIFFFAHRT UND HYDROGRAPHIE

Baumusterprüfbescheinigung
type examination certificate no.

Nr. BSH/6161/001/2004

Die Navigationsausrüstung / *The Navigation equipment:*

Schnittstellenwandler für Gyro-Kompasse
Gyro converter

mit der Typbezeichnung / *with the type designation* **S2N Gyro converter**

des Herstellers / *of the manufacturer*

qwerty-elektronik
Bälinge Klockargård
SE-610 60 Tystberga ; Sweden

ist nach den folgenden Normen/Standards geprüft worden
has been type-tested in accordance with the following standards

Norm/Standard		Prüfnorm/Test standard
General Requirements	IMO A.694	IEC 60945 (2002) IEC61162-1, -2

erfüllt die Anforderungen hinsichtlich Genauigkeit der Datenwandlung, Fehlerbehandlung und verarbeiteten Drehrate zum Anschluss an Navigationssysteme und wird für den Antragsteller
complies with the requirements of connected navigational systems i.e. accuracy of conversion, error handling and accepted turn rate and has been approved for the applicant

wie oben / *as above*

für den nachstehenden Verwendungszweck zugelassen:
for the following application:

Einsatz als Schnittstellenwandler für Gyrokompasse (analog, stepper) in serielles Datenformat zum Anschluss an Navigationssysteme wie z.B. RADAR, ECDIS, AIS, VDR sowie zusätzliche Gyro-Tochteranzeigen.
Gyro converter to convert syncro/stepper information to serial IEC 61162-1/-2 data format to connect navigational systems as e.g. RADAR, ECDIS, AIS, VDR and additional GYRO repeater displays.

Geprüft wurde die Version / *Tested version was* S2N Gyroconverter 9028C S/N 10252; SW version 0-6.xx .

Die Zulassung berechtigt zur Anbringung der Baumusternummer (Nummer der Baumusterprüfbescheinigung).
With the approval it is granted, that the equipment can be labelled with the type approval number (number of the type approval certificate).

Hamburg, **26.05.2004**

Im Auftrag
on behalf
Preuss

Dienstsiegel
Official seal

Vers. 04.05.2004